

MOBILE BOOK OF SOLUTIONS TO II PU STATISTICS

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If we want to test the null hypothesis that the population has a specified mean μ_0 .

i.e. $H_0 : \mu = \mu_0$
V/S $H_1 : \mu \neq \mu_0$ (2TT)
OR V/S $H_1 : \mu < \mu_0$ (LTT)
OR V/S $H_1 : \mu > \mu_0$ (RTT)



By - Toppers II P.U. Statistics Students (2014)
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Mobile Book Of Solutions to II PU Statistics Text

Dedicated to
All II PU Statistics Students



By Toppers IIPU Statistics Students
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Recently we are blessed with two letters -

One is for students -

“ Role of statistics “

Another is to statistics teachers -

“ Teaching of Statistics “

by Living Legend, Moving God of statistics, **Prof. C.R. Rao Sir** at his 95th age.

We are all very much thankful to him and great salutations to the Doyen of statistics Prof. C.R. Rao Sir.

- Editor and students

C.R. Rao, Sc.D., FRS
Padma Vibhushan Awardee
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17 February, 2015

Dear students of S.R.S.P.U. College,

Thank you for your kind letter. As desired by you I am sending you my views about statistics, a discipline of great importance in all our activities. A physicist studies physics in order to solve a problem in physics. A chemist studies chemistry in order to solve a problem in chemistry. A botanist studies botany in order to solve a problem in botany. A statistician studies statistics not to solve a problem in statistics but to solve problems in all areas of human endeavor.

Statistics is important for the government to make wise policy decisions for the welfare of the people. Statistics will be of use to scientists in conducting well designed experiments to verify their hypotheses. Statistical methods are of great value in designing a product and

controlling its quality during production. Statistics plays an important role in courts of law to decide cases of disputed paternity and disputed authorship of a document. Statistics in the form of information is of great value for an individual to make wise decisions under uncertainty in his or her daily activities. These are a few examples of the use of statistics.

You have to do research in statistics to refine the existing methodology and to add new methods to cover possible cases that may arise in future. I am reminded of what Ian Hacking said: *The quiet statisticians have changed the world not by discovering new facts or technical developments but by changing the ways we reason, experiment, and form our opinions about it.*

You are studying a subject of great importance in enhancing our activities in all walks of life and contribute to welfare of the people. You have a great role to play after you acquire a good knowledge in statistics. I wish you good luck in all your activities.

C. R. Rao

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21 February 2015

Dear Professor Hegde,

Statistics is an interesting subject to teach. To the fresh students who have not taken any courses in statistics, I usually pose a problem such as what is the sex ratio of male to female children at birth. The students would say one to one. I ask them. How do you know? They say we can verify by collecting data. How do you collect data of this kind? What is the best source for such data? They may not know. I tell them: Go to the maternity ward of a hospital. They have a record of sex of each child in the order in which they were born. So we have statistics of the type:

MMFMFM.....

How do we characterize such a sequence?
I ask them to throw a coin a number of times
and record the sequence of heads and tails.

HTHHHTT-----

Do the 2 sequences look alike? Now one can
talk about histograms based on the number
of M's in sets of 5 in the first sequence and
the number of H's in sets of 5 in the second.
The similarity confirms that the mechanism of
sex determination of children born is similar
to the sequence of heads and tails in coin
tossing.

You should be able to introduce each statisti-
cal method through available data or asking
students to collect data. You may ask what the
sex ratio of male to female is in the general
population. You can introduce sample surveys
by asking students to collect data from house-
holds to estimate sex ratio. Why choose some
houses at random? Recently there has been
some controversy about tests of significance.
If you want to test if drug A is better than drug
B in curing a certain disease, we test the hy-
pothesis that the difference is zero. In general
the effects any two drugs will be different,
which may be small. The question to be asked
should be how different the two drugs are,

which leads us to estimation of the difference through confidence intervals. The situations where a test is needed should be discussed in class.

Statistics is the science, technology and art of developing human knowledge through the use of empirical data. It plays an important role in all areas of human endeavor for decision making. To an individual, statistical information is needed to make safe decisions in daily life.

Best regards.

C. R. Rao

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Sonali



Shrenik



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Harsh D.N.

**We Welcome - Any Suggestions,
Corrections and Comments
Regarding this book with Thanks**



UNIT-I VITAL STATISTICS

1. Define Vital Statistics
Vital Statistics are the numerical records, analysis and interpretation of vital events.
2. Mention a source of vital statistics.
 1. Registration method
3. Write the formula for estimating the population between two census years.
$$P_t = P_o + [B_t - D_t] + [I_t - E_t]$$
4. Mention a use of vital statistics.
It helps in planning and framing policies.
5. Define fertility
Fertility is the number of births occurring to woman of child bearing age.
6. Define fecundity
Fecundity refers to the capacity of a woman to bear children.
7. Define crude birth rate.

$$CBR = \frac{B}{P} \times 100 \text{ where,}$$

B= No. of live briths
P=Total populcation

8. Generally what is the child bearing age for women?
15 - 49 years

9. Give the formula for calculating general fertility rate.

$$GFR = \frac{\text{Number of live births}}{\text{Total female population of age 15 - 49}} \times 1000$$

10. Give the formula for calculating age specific fertility rate.

$$ASFR = \frac{\text{Number of live births in the age}}{\text{Total female population of age 15 - 49}} \times 1000$$

11. Define gross reproduction rate.

$$GRR = i \times \sum WSFR \text{ Where,}$$

WSFR = Women Specific Fertility Rate

12. Define net reproduction rate.

$$NRR = i \times \sum WSFR \times S$$

Where, S = Survival Ratio

13. What is life table?

Life table is the tabular presentation of numerical data describing the mortality experience of a cohort.

14. Mention any one use of life table.

It is used in actuarial science such as life Insurance companies.

15. Define longevity

Expected number of years that a new born baby would live.

16. Define cohort.

Group of individuals who are born at same time and experience the same mortality conditions.

17. Define radix.

Radix is the size of the cohort

Radix=100000 persons

18. What is mortality rate?

The number of deaths occurring per 1000 persons.

19. What is survival ratio?

The probability of person of age 'x' survives upto age 'x+1'

20. Define expectation of life.

Expected number of years a person of age x would live.

21. What is Mortality ratio ?

The probability of person of age ' x ' would die before age ' $x+1$ '

22. What is average population?

It is the average of the population in the beginning at the end of the year.

23. If the population in a city at the beginning of a year is 693489 and at the end of the same year is 693899 find the average population.

$$\text{Avg Populn} = (693489 + 693899) / 2 = 693694$$

24. What is standard population ?

The ASDR depends on the geographical area. It cannot be possible to compare over all mortality pattern in two different places. The population which is taken common for the two regions for comparison is called standard population.

25. Mention the measures used to compare.

a) fertility (Performances) rates

b) Health conditions

Ans.: a) TFR b) STDR

Note :

Fertility rates :

CBR is crude measure (does not consider age & sex composition.

GFR considers only female population (advantage over CBR)

ASFR considers female population of specific age group. (advantage over GFR)

TFR considers quinquennial ages and female population. can be used for comparison. (advantage over ASFR)

Growth rates.

GRR considers only female births.

NRR it takes survival ratio into consideration. (advantage over GRR)

Mortality rates :

CDR is a crude measure (does not consider age and specific causes)

ASDR considers age groups (advantage over CDR)

STDR consider age groups and can be used for comparison (advantage over ASDR)

two marks questions

26. Mention any two vital events occurring in human population.

1. Marriage 2. Birth
3. Death 4. Sickness

27. Mention any two methods of obtaining vital statistics.

1. Registration method
2. Census method
3. Estimation method

28. Explain briefly registration method of collection of vital statistics.

It is a compulsory, regular and continuous record of vital events. This method will be successful, if there is a legislation regarding the registration of vital events.

29. Mention any two uses of vital statistics.
1. It helps in planning and framing policies.
 2. They are essential in demographic research
 3. It is used in actuarial science.
30. Mention any two fertility rates.
1. Crude birth rate
 2. Total fertility rate
31. Mention any two mortality rates.
1. Crude death rate
 2. Standard death rate.
 3. Specific death rate
32. Interpret TFR = 2314
- TFR = 2314 means the number of

children born to a woman in her life time is equal to 2.314 i.e. 2 (approx)

33. What is the meaning of $NRR = 896$
 $NRR / 1000 = 0.896$ i.e. less than 1,
the population is decreasing.

34. Define IMR

$$IMR = \frac{\text{Number of deaths among infants in the yr}}{\text{Total number of live births in the same year}} \times 1000$$

35. Define NMR

$$NMR = \frac{\text{Number of deaths of neonatal babies in a yr}}{\text{Total number of live births in the a year}} \times 1000$$

36. Define MMR

$$MMR = \frac{\text{Number of deaths of mothers due to child birth in the yr}}{\text{Total number of live births in the same year}} \times 1000$$

37. What is the meaning of $GRR = 1092$
 $GRR / 1000 = 1.092$ i.e., the population is almost constant.

38. What is demography.
The statistical study of human population.

(29 to 38 are
one Marks Questions)

39. In a life table, if $l_1 = 95400$ and $l_2 = 93492$ then find survival ratio and mortality ratio of the first year.

$$d_x = l_x - l_{x+1} \quad d_1 = l_1 - l_2 = 95400 - 93492 = 1908$$

$$\text{Mortality ratio} = q_x = d_x / l_x = \frac{1908}{95400} = 0.02$$

$$\text{Survival ratio} = 1 - q_x = 1 - q_1 = 0.98$$

40. In a life table, if $l_1 = 95400$ and $T_1 = 6105600$ then find expectancy of life in the first year.

$$\text{Ans: } e_x^o = T_x / l_x \quad T_1 / l_1 = \frac{6105600}{95400} = 64 \text{ years}$$

41. In a life table, if $l_0 = 100000$ and $T_0 = 65,00,000$ yrs then find longevity.

$$\text{Ans: Longevity} = e_0^o = \frac{T_0}{l_0} = \frac{6500000}{100000} = 65 \text{ years}$$

42. In a life table, if $l_1 = 98200$, $d_1 = 1100$ then find L_1 .

$$\text{Ans: } L_x = \frac{l_x + l_{x+1}}{2} = \frac{l_x + (l_x - d_x)}{2} = l_x - \frac{d_x}{2}$$

$$L_1 = l_1 - \frac{d_1}{2} = 98200 - 550 = 97650$$

43. Mention the difference between CBR & ASFR

Ans : i. CBR is the average no. of live births occurring among the total population. where as ASFR is the average no. of live births in the specific age group per 1000 women

ii. CBR does not consider the age & the sex composition of the population. ASFR includes the age & the sex composition of the population.(advantage over GFR)

44. Mention the differences of CDR & ASDR.

Ans : i. Write the two formulae

ii. CDR does not consider the age group of the population but ASDR considers it.

45. State the two differences of GRR & NRR.

Ans : i. Write the two formulae

ii. GRR considers female births only (advantage over ASFR). NRR considers Survival ratio of females (advantage over GRR)

46. Mention the difference between CDR & STDR

Ans : i. Mention the formulae

ii. CDR does not consider age composition but STDR consider.

iii. STDR needs standard population

iv. CDR can't be used for comparison STDR is used for comparison.

47. In a Year, in a community there were 7800 live births. The number of infants died in the year was 385, of the infant deaths in 20 cases the new born baby died within one month. find IMR & NMR

Ans : IMR= formula

$$=(385/7800) \times 1000 = 49.359$$

NMR=farmula

$$=(20/7800) \times 1000 = 2.5641$$

48. If $\Sigma PA = 580196$ and $\Sigma PB = 600981$
 $\Sigma P = 100000$, what is your conclusion?

$$\text{STDR (A)} = 580196 / 100000 = 5.80196$$

$$\text{STDR (B)} = 600981 / 100000 = 6.00981$$

since $\text{STDR (A)} < \text{STDR (B)}$

Population at A is healthier.

32. Write down the limitations of price index number.

- I
N
- a. As the customs & habits change from time to time the uses of commodities also change
 - b. Different formulae give different results.
 - c. There is scope of bias.
-

33. Define circular test.

- I
N
- In order to satisfy this test the index number has to work in circular manner and this property enables us to find the index number from period to period without referring back to the original base year.

49. Find IMR, NMR & MMR

Age in weeks	00-04	04-08	08-24	24-36	36-52	
52&above	livebirths	1500	3900	6800	6900	5200
6800						
No. of deaths	45	65	175	150	180	258
Mothers died						
due to child birth	5	4	3	4	6	8

IMR = formula= $\frac{615 \times 1000}{24300} = 26.3374$

NMR = farmula= $\frac{045 \times 1000}{24300} = 1.8519$

MMR = farmula= $\frac{025 \times 1000}{24300} = 0.9535$

50. Calculate MMR

Age	10-20	20-25	25-30	30-35	35-40	
40&above	No. of	2000	3000	4600	2000	300
100						
livebirths						
No. of death	25	18	24	20	10	2
Mothers due to						

$$\text{child birth MMR} = \frac{\text{Number of deaths of mothers due to child birth in the yr}}{\text{Total number of live births in the same year}} \times 1000$$

$$= (99/12000) \times 1000 = 8.25$$

UNIT II : INDEX NUMBER

1. What is an Index number?
Index number are statistical devices designed to measure relative level of group of related variable over a period and place.
2. Why index numbers are known as economic barometers?
Index numbers are the indicators which reflects the changes over a period of time in prices, quantity and value etc. like barometer measures changes in atmospheric temperature.
3. What is meant by simple index number?
Simple index number is an unweighed index number which consist in expressing total price or total quantity.
4. What is meant by composite index numbers?
When the change in average level

of a number of items is being studied collectively this index numbers is termed as composite index number.

5. Define price relative?

Price relative is the price in the current year (p_1) expressed as percentage of the price in the base year (p_0)

6. Mention one use of index numbers?

Index numbers are used in studying trends and tendencies.

7. Mention one limitation of index numbers?

It is based on samples which are approximate indicators.

8. What is meant by price index numbers, quantity index numbers, and value index numbers?

Index numbers are statistical device designed to measure of relative price / quantity / value level of group of related variables.

9. What is the value of index number for the base year?
100
10. What is mean by fixed base index number?
If the period of comparison is kept fixed for all current years it is called fixed base period.
11. What is meant by chain base index number?
If the relative changes in the level of phenomenon for any period are compared with that of immediate preceding period is called chain base index number ($P_{0K} = P_{01} \times P_{12} \times P_{23} \dots P_{K-1 K}$)
12. If price during current year is triple the price during the base year what is the index number?
300
13. if the current year price index is 175, what would you conclude?

75% increase in the price level.

14. Price index for the current year with respect to base year is 140 if the price of a commodity in the base year is Rs. 60, then what would be the price in the current year?

$$P_{01} = P_1 / P_0 \times 100,$$

$$140 = x / 60 \times 100 = 84$$

X=84 i.e. price in the current year in Rs. 84

15. Quantity index number for current year is 250 if the number of units produced in current year is 120 then find the number of units produced in the base year?

$$250 = (120/x) \times 100$$

$$\Rightarrow x = 120 \times 100 / 250 = 48$$

16. If the cost of living index for a current period is 90, then what would you conclude?
There is 10% decrease in the price level.

17. Write down the formula of paasche's price and quantity index number?

$$P_{01}^P = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100$$

18. What is meant by quantity weights?

Quantity weights means the amount of commodity produced or consumed during a period.

19. What is meant by value weights?

Value weight means quantity produced multiplied by the price of quantity.

20. Why an index number based on AM would be higher than an index number based on GM.

Because A.M. gives greater weight age to bigger items.

21. Write down the expression for Kelley's fixed weight index number?

$$P_{01}^k = \frac{\sum P_1 Q}{\sum P_0 Q} \times 100$$

22. If the quantity index number for current year is 80, then what would you conclude?
There is 20% decrease in the quantity level.
23. Which system of weights is used in construction of laspeyer's price index number?
Base period quantity.
24. Which system of weights is used in construction of paasche's index numbers?
Current year Quantity or price.
25. Which system of weights is used in the construction of

Marshall Edgeworth's and Fisher's index number?
Average of base period and current period weights for Marshall Edgeworth Index Number and for Fisher index number both base period and current period weights are considered.

26. State the relation between Laspeyre's, Paasche's and Fisher's indices?
Fisher index number is the G.M. of Laspeyre's and Paasche's IN.
27. State the relation between Laspeyre's, Paasche's and Dorbrish Bowley's IN
Dorbrish Bowley's IN is the AM of Paasche's and Laspeyre's index number
28. State the condition required to satisfy time reversal test ?

P_{10} & P_{01} should not be expressed as percentage.

29. State the condition required to satisfy factor reversal test (FRT)?

Price Index x Quantity index
= Value index i.e. change in
price x change in
quantity = change in value

30. Name the index numbers which does not satisfy unit test?

All other index number except Kelley's IN does not satisfy unit test.

31. Name the index numbers which satisfy TRT?

Marshall Edgeworth & Fisher's IN satisfy TRT.

32. Name the index numbers which satisfy TRT?

Marshall Edgeworth & Fisher's IN satisfy TRT.

33. Name the index numbers which satisfy FRT?
Fisher index number
34. Name the index number which satisfy both TRT & FRT?
Fishers index number
35. Name the index number which satisfy circular test?
Kelley's IN and simple IN based on G.M.
36. Define consumer price index numbers (Cost of living index number)?
CPI is the cost met by a specified class of consumer in buying basket of goods & services.
37. Which price of the commodities is used in the construction of CLIN?
Retail / wholesale Price
38. Theoretically which average is

considered as the best average in the construction of index numbers?

Geometric mean (G.M.)

39. Name the common average used in construction of index numbers?

A.M. & G.M

40. State the formula for computing CPI by family budget method?

$$CPI = \frac{\sum PW}{\sum W} \quad \text{Where}$$
$$P = (P_1/P_0) \times 100$$
$$W = \text{weights}$$

41. State the formula for computing CPI by aggregate expenditure method?

$$CPI = \frac{\text{Total expenditure in the current year}}{\text{Total expenditure in the base year}} \times 100$$

* Name the PIN which shows upward bias and downward bias

Ans: La shows upward & Pa shows downward bias

42. If the general price level goes up by 80% between 2002 and 2012, what is the index number for 2012 with base 2002?
Price index number for 2012 = 180%

43. What is the relationship between laspeyre, paasches and marshal Edgeworth price index numbers.

If $P_{01}^L < P_{01}^p$, Then $P_{01}^L < P_{01}^{ME} < P_{01}^p$

If $P_{01}^L > P_{01}^p$, Then $P_{01}^p < P_{01}^{ME} < P_{01}^L$

44. Mention the methods of constructing CPI

i. Aggregate expenditure method

ii. Family budget method.

45. Why index numbers are called as special type of average ?

Index numbers are designed to show an average change in different related variables. measured in different units. so they are called as special average.

46. What is meant by normal period ?

It is one which is economically stable.

47. Distinguish between weighted and unweighted (simple) index number.

In weighted index number due to weightage is given to different items in relative way (equal importance is not given to all) whereas in unweighted index numbers weights are taken uniformly.

Two Marks Question

1. State the two uses of index number.
 - a. Index numbers are the

economic Barometer

- b. Studies trends & tendencies
 - c. Helps in formulating decisions & policies
2. State two limitations of Index numbers.
- a. It is based on sample
 - b. There is scope of bias
 - c. Different index number give different result
3. State two characteristics of index number?
- a. It is specialised type of average.
 - b. It is expressed in ratio expressed in percentage.
4. Define index number?
Index number is statistical device designed to measure the relative changes in the level of group of related variables over a period of time or place.
5. Mention the steps involved in

the construction of general price index number?

- a. Defining the purpose of index number
 - b. Selection of base period
 - c. Selection of commodities item
 - d. Obtaining price quotation
 - e. Choice of an average
 - f. Selection of weights
 - g. Selection of suitable formula
6. State any two consideration for the selection of base period?
- Base period should be economically stable.
 - The base period should not be distant from the given year.
7. What do you mean by current period & base period?
- Base period is one with respect to which time period the index number is expressed
- Current period : It is one in which the index number is

measured.

8. Briefly explain unit test.
The test is one in which index number should be independent of the units in which price or quantities of various commodities are quoted.
9. Briefly explain TRT and FRT
 $TRT = P_{01} \times P_{10} = 1$
where P_{01} = the price index for the current year 1 w.r.t. base year 0
 P_{10} the price index for the current year 0 w.r.t. base year 1
 $FRT = P_{01} \times Q_{01} = V_{01}$ where
 Q_{01} = the quantity index for the current year 1 w.r.t. base year 0
10. Briefly explain circular test.
Circular test is the extension of TRT for more than two period and based on the shiftability of the base period.

$$P_{01} \times P_{12} \times P_{20} = 1$$

11. Why Fisher's index number is called 'Ideal Index Number'?
Fisher's index number is regarded as Ideal Index number because
 - a. It considers both base and current period
 - b. It is free of bias
 - c. It is based on GM
 - d. It satisfies TRT and FRT
12. Why Laspeyre's index number shows upward bias?
Laspeyre's index number is based on base period quantity. It gives more weightage for such commodities than needed. So it shows upward bias.
13. Why passche's index number shows down ward bias?
Paasche's index number which uses the current year quantity

as weights. It is generally an under estimate so it shows downward bias

14. Why Fisher's index number is free from bias?
Fisher's index number uses both base period and current period quantities and is based on GM.
15. Write down any two assumptions made in the CPI?
 - a. There should not be drastic change in the prices of the commodities
 - b. The consumption pattern should be same within the class.
16. Write down the steps involved in the construction of consumer price index number?
 - a. Defining purpose and scope.
 - b. Conducting family budget enquiry
 - c. Obtaining price quotation

- d. Selecting items.
- e. Selecting suitable formula
17. Write down any two uses of CPI.
 - a. CPI evaluates the purchasing power of money.
 - b. CPI is helpful for computing the real wages.
18. If laspeyre's index is 142.3 and paasche's index is 144.1. Find
 - i. Fisher's index
 - ii. Dorbish – Bowley's index
$$D-B IN = (142.3 + 144.1) / 2 = 143.2$$

$$F-IN = \sqrt{142.3 \times 144.1} = 143.1972$$

19. If $P_{01}^P = 270$ and $P_{01}^{DB} = 265.4$ then find P_{01}^L

$$P_{01}^{DB} = 1/2 (P_{01}^L + P_{01}^D)$$

$$265.4 = 1/2 (P_{01}^L + 270)$$

$$P_{01}^L = 260.8$$

20. If $P_{01}^L = 92$ and $P_{01}^F = 95$ then find P_{01}^P

$$P_{01}^F = \sqrt{P_{01}^L \times P_{01}^P}$$

$$95 = \sqrt{92 \times P_{01}^P} \quad \text{i.e. } P_{01}^P = 98.1$$

21. Given $\sum P_0 Q_1 = 300$ and $\sum P_1 Q_1 = 375$ construct suitable price IN.

$$P_{01}^p = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100$$

Ans : 125%

22. Construct CPI from the following data.

Items	Group index	Weight
A	100	1
B	120	3
C	130	4
D	110	2

$CPI = \frac{\sum I W}{\sum W} = \frac{1200}{10} = 120\%$
there is 20% increase in general price level.

23. Given $\sum P_1 Q_1 = 500$
 $\sum P_0 Q_1 = 450$ construct suitable IN.

$$P_{01}^p = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100 = 111.11\%$$

UNIT III : TIME SERIES

1. Define time series? Give an example.

Time series is a chronological arrangement of statistical data. Example : Sale of commodity in a shop in different time period.

2. Define secular trend. Give an example.

The general tendency of data to increase or decrease or to remain a constant during a long period of time is called secular trend.

Eg: Increase in the price of gold in the past many years is an upward trend.

3. Define seasonal variation? Give an example.

The regular, periodic and short term variation in a time series is called seasonal variation.

Eg: Umbrellas are sold more in rainy season.

4. Define cyclical variation? Give an example.

Cyclic variation is an oscillatory variation which occurs in four stages namely i) prosperity ii) decline iii) depression iv) improvement

Eg : an era of depression

5. Define random variation. give Example ?

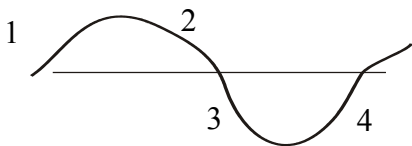
Random variation is the sudden and unexpected variation of the data Eg : sudden increase in death rate of place due to earthquake, floods, wars etc.,

6. What is Histogram ?

The graph of time series is called histogram.

7. Which index is used for the measurement of seasonal variation ?
Seasonal indices are used for the measurement of seasonal variation.
8. Mention a cause of the following variation.
1. seasonal variation
 - b. Climate and weather condition (natural forces)
 - c. Customs, traditions and habits of people. (Manmade conventions)
2. Cyclical variation
changes in economic and business activities causes C.V.
3. Irregular variation.
Sudden unexpected events such as war, floods, strikes lockouts etc causes irregular variation

9. Which variation is predictable?
Seasonal variation is predictable.
10. Which variation is unpredictable?
Random variation is unpredictable.
11. Which components of time series are associated with the following sentences.
a. fall in death rates due to advance in science.
-Secular trend
b. An increase in employment during harvest season.
-Seasonal variation
12. Diagrammatically represent 'Business cycle' (CV) with stages.



1. Prosperity 2. Decline
3. Depression 4. Recovery

13. Name two methods of measuring trend.

- a) Method of moving average
- b) Least square method

14. Explain with merits and demerits of the method of moving average for measuring trends?

Merits of moving averages:

- a) It is simple and easy to understand
- b) It is more flexible than other hands.
- c) It is not only used for the measurement of trend, but also for the measurement of seasonal, cyclical and irregular variations.

Demerits:

- a) Method does not provide the trend values at the beginning and at the end of the time series.

- b) Statistician uses his own judgment regarding the choice of the period.
15. Explain with merits and demerits the method of least squares for measuring trend.
- Merits :
- a) It is highly efficient
 - b) It can be used for forecasting the future trend
 - c) Further statistical analysis
- Demerits :
- a) The procedure for calculation is difficult
 - b) The general form of the relation has to be determined by judgment.
16. What is the duration of S.V ?
One year
17. Name the measure used to find S.V ?
Seasonal Indices
18. Which variation is unpredictable

able and which is predictable ?
R.V and S.V

19. Identify the independent variable and dependent variable in T.S data.
Time is the independent variable and value is the dependent variable.
20. Identify the component of T.S. in the following cases.
- a. Increase in the number of deaths of pilgrims due to floods and land slides in Uttarakhand (R. V.)
 - b. Fire accidents in a factory (R.V.)
 - c. Increase of woollen goods during winter (S.V.)
 - d. Fall in death rates due to advances in science (Trend)
 - e. In era of prosperity (C.V.)
 - f. Deaths tsunami (R.V.)
 - g. Increase in passengers in Train during Holidays. (S.V.)

21. What is meant by M.A. ?
Moving Averages are obtained by finding the A. M.s of successive values of the T.S.
22. What is the use of finding M.A.?
It helps to eliminate short term variations that are present in T.S.
23. Mention the the principles of method of Least squares. It is based on the properties of A.M.
- i. The sum of the deviations of the observations from A.M. is 0
 - ii. The sum of the squared deviations of the observations from A.M. is minimum
24. What is semi average method of measuring trend ?
It is the method of dividing the original values of T.S. in two equal parts and finding the

averages of both the parts.

25. Mention the merits of Least squares method.

The merits of L.S.M. (advantage over MMA)

i. Trend values can be obtained for all the years.

ii. Future values can be estimated.

NOTE :

1. Linear equation is $Y=a+bx$

The normal equations to find a and b

$$\begin{aligned}\sum Y &= Na + b \sum x \\ \sum xy &= a \sum x + b \sum x^2\end{aligned}$$

$$a = \frac{\sum Y}{N} \text{ and } b = \frac{\sum xy}{\sum x^2}$$

Quadratic (2nd degree) Equation is
 $y=a+bx+cx^2$

The normal equations to find a,b,c

$$\begin{aligned}\sum Y &= Na + b \sum x + c \sum x^2 \\ \sum xy &= a \sum x + b \sum x^2 + c \sum x^3 \\ \sum x^2y &= a \sum x^2 + b \sum x^3 + c \sum x^4\end{aligned}$$

3. Exponential equation $y=ab^x$
 normal equations to find a and b
 $\sum \log y = N \log a + \log b \sum x$
 $\sum x \log y = \log a \sum x + \log b \sum x^2$

4. Mention the uses of T.S. analysis
- i. To understand past behaviour of data.
 - ii. To measure current changes.
 - iii. To predict future value.

UNIT IV : INTERPOLATION AND EXTRAPOLATION

1. Mention different methods of interpolation.
 - a) Binomial expansion method
 - b) Newton's advancing difference method
2. What is interpolation?
Interpolation is the technique of estimating the value of the dependent variable (y) for any intermediate value of the independent variable (x)
3. What is meant by extrapolation?
Extrapolation is the technique of estimating the value of the dependent variable (y) for any value of the independent variable (x) which is outside the range of the given series.
4. Write down the assumption of interpolation and extrapolation.

- a. There is no sudden jumps in the values of dependent variable from one period to another.
 - b. There is a sort of uniformity in the rise or fall of the values of the dependent variables.
 - c. There will be no consecutive missing values in the series.
5. Differentiate between interpolation and extrapolation.
 Interpolation Extrapolation
 Finding the value within the range is interpolation, finding the value of the independent variable outside the range of series is extrapolation.
6. Write down the conditions for application of binomial expansion method of interpolation.
- a. The values of the independent variable should have a common difference.

b. The value of x , for which the value of y is to be interpolated must be one of the values of x .

7. Write down the formula of binomial expansion method for 5 known values of 'y'

$$(Y-1)^5 = Y_5 - 4Y_4 + 6Y_3 - 4Y_2 + Y_1 = 0$$

8. Write the formula to find the value of 'x' in finding the missing value of 'y' using Newton's method of interpolation.

$X = (\text{The value of } x \text{ to be interpolated} - \text{the value of } x \text{ at the origin}) / (\text{The difference between the two adjoining values of } x)$

UNIT V : THEORETICAL

DISTRIBUTIONS

1. Define a Bernoulli Variate.
A random variable x is said to be Bernoulli variate if its pmf is given by
$$\text{pmf} = p(x) = p^x q^{1-x},$$
$$x=0,1 \quad 0 < p < 1$$
2. Define a Bernoulli distribution.
A discrete probability distribution is said to be Bernoulli if its
$$\text{pmf} = p(x) = p^x q^{1-x},$$
$$x=0,1 \quad 0 < p < 1$$
3. Write down the probability mass function of Bernoulli distribution.

or

x	0	1
$p(x)$	q	p

4. Write the range and parameter of Bernoulli distribution.
Range = 0, 1
Parameter = p
5. Give an example for Bernoulli Variate.
Number of heads obtained in the toss of a coin.
6. Write the relationship between mean and variance of a Bernoulli distribution.
Mean > variance
7. What are the mean and variance of a Bernoulli distribution?
Mean = P
Variance = pq
8. What is meant by Bernoulli trial? Give an example.
A Bernoulli trial is one in which there are only two outcomes and probability of success is fixed always.

Ex: Getting an odd number while rolling a die.

9. If x_1, x_2, \dots, x_n are independently identically distributed Bernoulli variates with parameter P , what is the distribution of $x = x_1 + x_2 + \dots + x_n$?
Binomial distribution
10. Write down the Bernoulli distribution with parameter $p=0.23$.
 $Pmf = (0.23)^x (0.77)^{1-x}$
11. If $P = 1/4$ for a Bernoulli distribution, write down the pmf also find variance.
 $Pmf = (1/4)^x (3/4)^{1-x}$
 $Variance = 1/4 \times 3/4 = 3/16$
12. Find the mean and variance of a Bernoulli distribution with parameter $P=0.43$.
Mean = $P = 0.43$
Variance = $pq = 0.43 \times 0.57 = 0.2451$

13. Write down the Bernoulli distribution with parameter $P=2/5$
 $Pmf = (2/5)^x (3/5)^{1-x}$
14. For a Bernoulli distribution, If $P=0.27$ write the p.m.f. also find SD.
 $Pmf = (0.27)^x (0.73)^{1-x}$
 $SD = \sqrt{0.27 \times 0.73} = 0.444$
15. Find the mean and variance of a Bernoulli distribution with parameter $P = 2/3 = \text{Mean}$
 $\text{Variance} = pq = 2/3 \times 1/3 = 2/9$
Binomial distribution
16. Define a binomial variate
 A random variable 'x' is said to be binomial variate if its
 $pmf = p(x) = {}^nC_x p^x q^{n-x}$,
 $x = 0, 1, 2, \dots, n$ $0 < p < 1$
17. Define a binomial distribution
 A random variable 'x' is said to follow binomial distribution if its

$$\text{pmf} = p(x) = {}^nC_x p^x q^{n-x},$$

$$x = 0, 1, 2, \dots, n \quad 0 < p < 1$$

18. Write down the range and parameter of a binomial distribution.

Range : 0, 1, 2,n

Parameter : p, n

19. Give two example of binomial variate.

1. Number of heads obtained in 4 tosses of a coin.
2. Number of male children in a family of 2 children.

20. What are the mean, variance and SD of a binomial distribution?

Mean = np

Variance = npq

S.D. = \sqrt{npq}

21. Write the relationship between mean and variance of a binomial distribution.

Mean > variance

22. Write down 2 feature of binomial distribution
1. n and p are the parameters.
 2. range = 0, 1, 2, n
 3. pmf = $p(x) = {}^nC_x p^x q^{n-x}$,
 4. Mean > variance
23. Mention the recurrence relation for successive probabilities in a binomial distribution with parameter n and p .

$$P(x) = \frac{(n-x+1)[p/q]}{x} p(x-1)$$
24. Mention the recurrence relationship for successive frequencies in a binomial distribution with parameters n and p .

$$Tx = \frac{(n-x+1)}{x} [p/q] Tx-1$$
25. Mention the conditions under which binomial distribution tends to Poisson distribution.
 n is large, p is small and $np = \text{constant}$

26. For what value 'p' is binomial distribution symmetrical?
 $P = 0.5$
27. The mean and variance of a binomial distribution are 4 and 5 respectively comment on this statement and give reason to your comment.
 The statement is wrong, because in a binomial distribution $\text{mean} > \text{variance}$.
28. In a binomial distribution, If $n=6$ and $p = 1/3$, find mean, mode and variance.
 $\text{Mean} = np = 6 \times 1/3 = 2$
 $\text{Mode} = \text{mean} = 2$ because np is integer
 $\text{Variance} = npq = 2 \times 2/3 = 4/3$
29. In a binomial distribution with 5 trials, the mean is 3. Find 'p' and the S.D.
 $n=5$ $\text{mean} = 3 = np$

$$p = 3/5 = 0.6 \quad q=0.4$$

$$SD = \sqrt{npq} = 1.0955$$

30. If a binomial distribution has mean 3 and variance 2, find the parameter.

$$\text{mean} = 3 = np$$

$$\text{Variance} = npq = 2$$

$$\text{i.e., } 2 = 3(q) \quad \text{So } 2/3 = q,$$

$$p = 1/3$$

31. The mean and the SD of a binomial distribution are 8 and 2 respectively. Find the parameter.

$$\text{mean} = 8 = np, \quad SD = 2$$

$$\text{Variance} = 4 = npq$$

$$npq/np = 4/8 = 1/2 = q$$

$$\text{since } np=8, \quad n=16$$

$$(n=16, p=1/2)$$

POISSON DISTRIBUTION

32. Define a poisson variate.
A random variable x which follows the
$$\text{pmf} = p(x) = e^{-\lambda} \lambda^x / x!$$
33. Write the range and parameter of a Poisson distribution.
Range = 0 to ∞
34. Give two examples for Poisson variate.
1. Number of deaths occurring in a city in a day
 2. Number of printing mistakes per page.
35. What are the mean, variance and S.D. of a Poisson distribution?
$$\text{mean} = \text{var} = \lambda, \text{SD} = \sqrt{\lambda}$$
36. Mention two features of a Poisson distribution.
$$\text{Pmf} = p(x)$$
$$\text{mean} = \text{var} = \text{parameter}$$
37. Mention the recurrence formula for successive-

probabilities in a Poisson distribution with parameter λ
 $p(x) = \frac{\lambda^x}{x!} p(x-1)$

38. Mention the recurrence formula for successive frequencies in a Poisson distribution with parameter λ
 $T(x) = \frac{\lambda}{x} T(x-1)$
39. Under what condition Poisson distribution tends to normal distribution?
When N is large and x is continuous variable
40. In a Poisson distribution of S.D. is 3, find its mean.
 $SD = 3$ $Mean = 9$
41. In a Poisson distribution if mean is 4, find its S.D.
 $S.D. = 2$
42. Find $p(x=0)$ in a Poisson distribution with mean 5.
 $Mean = \text{parameter} = 5$
 $p(0) = e^{-5} = 0.0067$ (table value)

43. In a Poisson distribution,
if $p(x=0) = 0.0408$, find
parameter
 $p(x=0) = 0.0408 = e^{-m}$
 $m = \text{par} = 3.2$ (table)
44. In a Poisson distribution if
 $p(x=0) = 0.1225$,
write down pmf.
 $P(0) = e^{-m} = 0.1225$, $m = 2.1$
 $\text{pmf} = e^{-2.1}(2.1)^x/x!$
45. In a Poisson distribution,
 $p(x=2) = p(x=3)$. Find $p(x=4)$.
 $P(x=2) = P(x=3)$ So $m=3$

$$p(x=4) = (e^{-3}(3)^3)/4! =$$

$$(0.0498(81))/24 = 0.1681$$

46. In a Poisson distribution, the
second probability term is half
of the first probability
term. Find the S.D.
 $P(1) = 1/2 p(0)$ $m=0.5$
S.D. = 0.7071
47. The first two frequency terms
of a Poisson distribution are

150 and 180 respectively. Find the next frequency term.

$$T_0 = 150, T_1 = 180$$

$$T_x = (m/x) T_{x-1}$$

$$T_1 = m/1 T_0 \text{ i.e. } 180 = m150$$

$$m = 1.2 \text{ \& } T_2 = (1.2/2)180 = 108$$

48. The second and the third frequency terms of a Poisson distribution are 100 and 80 respectively. Find the next frequency term.

$$T_1 = 100, T_2 = 80$$

$$T_2 = 80 = m/2 \times T_1 = m \times 100$$

$$m = 1.6$$

$$T_3 = m/3 \times T_2 = 42.67$$

49. Write down the first 3 terms of PD with mean=5

x	0	1	2
p(x)	e^{-5}	$5e^{-5}$	$5^2 e^{-5}/2$

HYPER GEOMETRIC DISTRIBUTION

50. Define a hyper – geometric variate.
A discrete random variable is said to be hyper geometric variate if its pmf is given by $P(x) = \frac{{}^a C_x {}^b C_{n-x}}{{}^{a+b} C_n}$ where $x = 0, 1, \dots, \min(a, n)$ parameters = a, b and n
51. Write down the range and parameters of hyper geometric distribution.
Range = $0, 1, 2, \dots, \min(a, n)$
Parameter = a, b and n
52. Give two example for hyper – geometric variate.
1. Number of boys in a committee when 5 boys are selected from 30 boys and 20 girls.
 2. Number of vegetarians in a sample of 8 selected from a hostel in which there are 12 vegetarian and 18 non vegetarians.

53. What are the mean, variance and S.D. of a hyper-geometric distribution.
 Mean = $na/(a+b)$
 Variance = $(nab(a+b-n))/((a+b)^2(a+b-1))$
 S.D. = $\sqrt{\text{variance}}$
54. Mention two features of a hyper – geometric distribution.
1. a, b and n are three parameter
 2. Range = 0, 1, 2..... min (a , b)
55. Under what conditions hyper – geometric distribution tends to binomial distribution.
 When (a+b) is large
 $a/(a+b)=p$
56. State the conditions which characterize the hyper geometric distribution.
1. The result of each draw can be classified into two categories.
 2. The probability of success changes on each draw
 3. The draw is repeated fixed

number of times from a finite population.

57. If $a=5$, $b=15$ and $n=3$, then find the variance of hyper - geometric distribution.

$$\text{Variance} = \frac{nab(a+b-n)}{(a+b)^2(a+b-1)}$$

$$(225(17))/(400(19)) = 0.5033$$

58. Write down the pmf and mean of a hyper geometric distribution whose parameters are $a=4$, $b=7$ and $n=5$

$$\text{Pmf} = P(x) = \frac{{}^4C_x {}^7C_{5-x}}{{}^{11}C_n}$$

$$\text{Mean} = na/(a+b)$$

$$= (5(4))/(4+7)=1.8182$$

59. For a hyper-geometric distribution the parameters are $a=7$, $b=5$ and $n=8$. What is the range of the hyper – geometric distribution? Also find the S.D.

$$\text{Range} = 0, 1, 2, \dots, 7$$

$$\text{S.D.} = 0.8409$$

60. For a hyper-geometric distribution the parameters are $a=7$, $b=5$ and $n=8$. What is the range of the hyper – geometric distribution? Also find the S.D.

Range = 0, 1, 2.....7

$$\text{S.D.} = \sqrt{\frac{nab(a+b-n)}{(a+b)^2(a+b-1)}}$$

$$= 0.408$$

Normal distribution

61. Define a normal variate.
A continuous random variable is said to be normal variate if its pdf = $f(x)$
formula (refer text)
62. Write the range and parameters of a normal distribution.
Range = $-\infty < X < \infty$
parameters = μ & σ
63. Give two examples for normal variate
1. Heights of students of college
 2. Weights of apples grown in an orchard

64. What are the mean, variance and S.D. of a normal distribution.

$$\text{Mean} = \mu \quad \text{S.D.} = \sigma \quad \text{var} = \sigma^2$$

65. What are the values of coefficient of skewness

$$B_1 = 0, \quad B_2 = 3$$

66. What is the probability that a normal variate takes a value greater than its mean?

remember :

$$p(x > M) = p(x < M) = p(z < 0) = p(z > 0) = 0.5$$

67. What is the total area under the normal curve?

1. The total area under normal curve is unity
2. The area under the normal curve between a & $b = p(a < x < b)$

68. Give the value of a normal variate for which probability is maximum. Write the maximum probability.

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}$$

the value is maximum at $x = \mu$

69. Define a standard normal variate.

A continuous random variable is said to be SNV if its p.d.f. is given by

$$f(z) = \frac{1}{\sqrt{2\pi}} \exp(-z^2/2)$$

70. Mention the range & parameters of SNV

Range is $-\infty < Z < \infty$
parameters = 0 & 1

71. What are the mean, variance and S.D. of a standard normal distribution?

Mean = 0 Variance = 1
S.D. = 1

72. Name the distribution for which variance and S.D. are equal. Standard normal distribution.

73. Write down the area property of normal distribution.

1. Total area = 1
2. $P(a < x < b) = \text{Area}(a, b)$

74. State five properties of a normal distribution.
 The normal curve is symmetric bell shaped
 Mean = median = Mode
 The curve is Asymptotic.
 The curve has points of inflexion
 if SD. = σ , then $QD=(2/3)\sigma$
 $MD=(4/5)\sigma$

75. Write down the p.d.f. of a normal distribution with mean 55 and variance 4.

$$f(x) = \frac{1}{\sqrt{2\pi}} \exp \left[-\frac{(x-55)^2}{2} \right]$$

76. Write down the area under the normal curve in 1
 $P(-1 < z < 1) = \text{area}(-1, 1)$
 $= \text{area}(-1, \infty) - \text{area}(1, \infty)$
 $= 0.8413 - 0.1587 = 0.6826$

77. In a normal distribution, given $p(-0.8 < Z < 0.8) = 0.5762$.
 Find $p(0 < z < 0.8)$
 $P(0 < z < 0.8) = 0.5762/2 = 0.2881$
 (Symmetry property)
 Note : also $P(-0.8 < z < 0) = 0.2881$
78. If the variance of a normal distribution is 9cms^2 , then find QD.
 $QD = 2/3 (3) = 2$
79. Find the QD and MD of a normal distribution with mean 30 and S.D. 6.
 $QD = 2/3 (S.D.) = 4$
 $MD = 4/5 (S.D.) = 4.8$
80. If $Q_1 = 30$ and $Q_3 = 70$, find the mode of the normal distribution.
 $\text{Mode} = Q_2 = (Q_1 + Q_3)/2$
 $= (30 + 70)/2 = 50 = \text{mean}$
81. In a normal distribution, if $Q_1 = 20$ and $Q_3 = 50$, then find mean, Q.D. and S.D.

$$\begin{aligned}\text{Mean} &= Q_2 = (Q_1 + Q_3)/2 \\ &= (20+50)/2 = 35 \\ \text{Q.D.} &= (Q_3 - Q_1)/2 = (50-20)/2 \\ &= 15 = 2/3 \text{ (S.D.)} \\ \text{S.D.} &= 22.5\end{aligned}$$

82. In a normal distribution mean and variance are 50 and 16 respectively. Find Q_1 and Q_3 .
 $Q_1 = M - 0.6475 \text{ S.D.}$
 $= 50 - 0.6745(4) = 47.302$
 $Q_3 = M + 0.6475 \text{ S.D.}$
 $= 50 + 0.6745(4) = 52.698$
83. If Z is a SNV and $p(z > k) = 0.05$, find the value of K .
 $\text{Area}(k, \infty) = 0.05$
 $k = 1.64 \text{ (table)}$
84. If Z is a SNV and $p(z > k) = 0.1$, find the value of K .
 $\text{Area}(k, \infty) = 0.1$
 $k = 1.28 \text{ (table)}$

CHI SQUARE DISTRIBUTION

85. Define a Chi-Square distribution.
A continuous random variable which has the p.d.f.
 $f(x^2) = K \exp(-X^2/2) (X^2)^{n/2}$
86. Write the range and parameter of a chisquare distribution.
Range = $(0, \infty)$
parameter = n
87. Define degrees of freedom.
Number of independent variable components in a distribution.
88. Mention 2 features of a chi-square distribution.
i. n is the parameter
ii. Range = $(0, \infty)$
iii. mean = n
iv. variance = $2n$
v. mode = $n-2$
vi. curve is positively skewed

89. If Z is a SNV, then name the distribution of z^2 and find its variance.
 Z^2 is chisquare variate with 1df
 Variance = $2(1) = 2$
90. If z_1 and z_2 are 2 independent SNVs, then name the distributyion of $z_1^2 + z_2^2$ and find its mean.
 The distribution of $z_1^2 + z_2^2$ is a chi-square distribution with 2 d.f. and its mean = 2
91. For a chi-square variate with 9 d.f., find mean and S.D.
 Mean = $n = 9$ SD = 3
92. For a chi-square variate with 10 d.f., $p(0 < X^2 < 9.34) = 0.5$. Find median and mode.
 Median = 9.34
 Mode = $n - 2 = 10 - 2 = 8$
93. For a chi-square variate x^2 with 14 d.f. $p(0 < x^2 < 13.339) = 0.5$. Find median and mode.

Median = 13.339

Mode = $n-2=14-2=12$

94. If variance of a chi-square variate is 14, what is its mean and mode.

Variance = $14=2n$

Mean = $n-7$

Mode = $n-2=5$

95. What is the d.f. for chisquare test for goodness of fit when one parameter is estimated.

d.f.= $n-c-1=n-1-1=n-2$

96. Name the frequency table for
a. bivariates b. attributes
a. bivariate table
b. contingency table

STUDENT'S T-DISTRIBUTION

97. Define a student's distribution.
A continuous random variable is said to follow t-distribution if its p.d.f. is given by
$$f(t) = K \frac{1}{[1 + t^2/n]^{(n+1)/2}}$$
98. Write down the range and parameter of student's distribution.
Range = $(-\infty, \infty)$
parameter = n
99. Write the mean, variance and S.D. of a student's distribution?
Mean = 0
Variance = $n/(n-2)$
S.D. = $\sqrt{n/(n-2)}$
100. Mention two features of t distribution.
$$f(t) = K \frac{1}{[1 + t^2/n]^{(n+1)/2}}$$

Range = $(-\infty, \infty)$
parameter = n ,

mean=0=median=mode

Variance = $n/(n-2)$

the curve is symmetric bell shaped.

kurtosis > 3

101. If the parameter at t distribution is 8, find mean & variance.

Mean = 0

Variance = $n/(n-2) = 8/(8-2)$
= 1.33

102. If $n=10$ for a student's distribution, find median & S.D.

Median = 0

S.D. = 1.118

103. If $n=4$ for a student's distribution, find its mode & variance.

Mode = 0

Variance = $n/(n-2) = 2$

UNIT VI : STATISTICAL INFERENCE

1. What is simple random sample?
If the sample is chosen in such a way that, the chance of selection of every unit in the population is equal then it is called simple random sample.
2. What is parameter?
A statistical constant of the population is called a parameter.
3. What is statistic?
A function of the sample value is called a statistic.
4. What is parameter space?
The set of all the admissible values of the parameter is called parameter space.
5. What is sample space?
The set of all samples of same size that can be drawn from a population is called sample space.

6. What is sampling distribution of a statistic?
The distribution of the values of a statistic for different samples of same size is called as sampling distribution.
7. What is standard error?
The standard deviation of the sampling distribution of a statistic is called its standard error.
8. Write the formula of S.E. (\bar{X})
$$\text{S.E. } (\bar{X}) = \frac{\sigma}{\sqrt{n}}$$
9. Given $\sigma^2 = 9$ $n = 36$ find S.E. (\bar{X})
$$\text{S.E. } (\bar{X}) = \frac{\sigma}{\sqrt{n}} = 0.5$$
10. Sizes of two samples are 50 & 100 population standard deviation are 20 & 10 find S.E. ($\bar{X}_1 - \bar{X}_2$)

write the formula

ans=3

11. If $p=0.02$ and $n=64$ then find

SE (p)

$$SE(p) = \sqrt{\frac{PQ}{n}} = 0.0175$$

$$Q=1-p=0.98$$

12. A lot contains 2% defective items, 40 items chosen from it. Another lot contains 1% defective items. 60 items chosen from it. Find $E(p_1 - p_2)$

and S.E. ($p_1 - p_2$)

$$n_1 = 40, p_1 = 0.02, Q_1 = 0.98$$

$$n_2 = 60, p_2 = 0.01, Q_2 = 0.99$$

$$\begin{aligned} \text{i) } E(p_1 - p_2) &= p_1 - p_2 \\ &= 0.02 - 0.01 \\ &= 0.01 \end{aligned}$$

$$\begin{aligned} \text{ii) } SE(p_1 - p_2) &= \sqrt{(P_1 Q_1)/n_1 + (P_2 Q_2)/n_2} \\ &= 0.0256 \end{aligned}$$

13. Write the formula of S.E. ($p_1 - p_2$), when $p_1 = p_2 = p$
- $$S.E. (p_1 - p_2) = \sqrt{PQ \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$
14. Write the utilities of standard error.
- Standard error is used to-
- Decide the efficiency and consistency of the statistic as an estimator.
 - Obtain the confidence intervals of an estimate.
 - Standardise the distribution of test statistic in testing of hypothesis.
15. What is statistical inference?
- Statistical inference is the theory of making the decisions about the population parameters using sampling and concept of probability.

16. Mention two branches of statistical inference.
Two branches of statistical inference are ;
a) Estimation
b) Testing of hypothesis
17. What is point estimation?
If a single value is proposed as an estimate of the unknown parameter then it is called as point estimation.
18. What is interval estimation?
If an interval is proposed as an estimate of the unknown parameter then it is called as interval estimation.
19. What is confidence interval?
An interval (T_1, T_2) which is proposed to contain the unknown parameter is called confidence interval.

20. What are confidence limits?
The boundary value of confidence interval are confidence limits.
21. What is confidence co-efficient?
The probability that a confidence interval contains the unknown parameter is called confidence co-efficient.
22. What is statistical hypothesis?
Give an example.
A statistical hypothesis is a statement regarding the parameters of the population.
Example, if a population is binomially distributed, then
 $H : n=10 \quad p=0.6$

23. What is null hypothesis? Give an example.
Null hypothesis is the hypothesis which is being tested for a possible rejection, under the assumption that it is true.
Example, If we want to test whether a particular drug is effective, then we set up the null hypothesis (H_0) as it is not effective. To test population mean $H_0 : \mu = \mu_0$
24. What is alternative hypothesis? Give an example.
Alternative hypothesis is the hypothesis which is accepted when null hypothesis is rejected.
Example, If we want to test the null hypothesis that the population has a specified mean μ_0

		$H_0 : \mu = \mu_0$	
	v/s	$H_1 : \mu \neq \mu_0$	2 TT
or	v/s	$H_1 : \mu > \mu_0$	R TT
or	v/s	$H_1 : \mu < \mu_0$	L TT

25. What is type I error?
The error of rejecting null hypothesis when actually it is true is called type I error.
26. What is type II error?
The error of accepting null hypothesis when it is actually not true is called type II error.
27. What is size of the test?
The probability of rejecting H_0 , when it is true is called size of the test. It is denoted by α
28. What is level of significance?
Maximum size of the test is called as level of significance.

29. What is power of the test?
The probability of rejecting H_0 , when it is wrong is called power of a test.
30. What is critical region?
Critical region is the set of those values of the test statistic, which leads to the rejection of the null hypothesis.
31. What is critical value?
Critical (significant) value is the value of test statistic which separates the critical region and the acceptance region.
32. What is two tailed test?
Two tailed test is a test of statistical hypothesis, where rejection region is located at both the tails of the probability curve of the null distribution of the test statistic.

33. What is one tailed test?
One tailed test is a test of statistical hypothesis, where the rejection region will be located at only one tail of the probability curve of null distribution of the test statistic.
34. What is null distribution?
The statistical distribution of the test statistic under the null hypothesis is called null distribution.
35. What is test statistic?
A statistic based on whose distribution the testing of hypothesis is conducted is called test statistic.

LARGE SAMPLE TESTS

36. Given $\bar{X} = 203$ gms,
M=200gms, s=10 gm and
n=64 calculate test statistic.
 $Z = \sqrt{n} (\bar{x} - M) / s = 2.4$
37. If $P_1 = 0.3$ and $P_2 = 0.2$ find
mean of $(P_1 - P_2)$
Mean $(P_1 - P_2) = P_1 - P_2$
 $= 0.3 - 0.2 = 0.1$
38. If in a large sample test, for
testing difference of means,
 $Z_{cal} = 2.21$ what is your inference at 1% Los and 5% LOS.
At LOS=1% CR=±2.58 Accept H_0
At LOS=5% CR=±1.96 Reject H_0

T-TEST

39. Write two applications of t-test?
- 1) Testing for single mean
 - 2) Testing for difference of means
 - 3) Paired t-test
40. Write down the t-test statistic and degree of freedom in case of testing for mean.
test statistic = $t_{cal} = \frac{\bar{x} - \mu}{s/\sqrt{n-1}}$
41. Write down the t-test statistic and degree of freedom in case of test for equality of means of 2 independent samples.
t-test statistic = formula (refer text) d.f. = $n_1 + n_2 - 2$
42. In paired t-test if $n=5$, $d=3$ $sd=1.5$ find test statistic.

$$\text{Test statistic} = \frac{\bar{d}}{sd/\sqrt{n-1}} = \frac{3}{1.5/\sqrt{5-1}} = 4$$
$$\text{d.f.} = n - 1 = 4$$

CHI-SQUARE TEST

43. Mention applications of testing for population variance.
testing for independence of attributes.
testing for goodness of fit.
44. Write χ^2 – test statistic with degrees of freedom in testing of population variance.
 $\chi^2_{\text{cal}} = ns^2 / \sigma^2$
d.f. = n-1
45. What is the value of d.f. in 2x2 contingency table?
Degree freedom = 1
46. For the χ^2 – test what is the condition for expected cell frequency?
Expected frequency >5

VII : OPERATION RESEARCH

1. Define linear programming problem?
A general LPP deals with the optimization of a linear function of variables subject to a set of linear constraints.
2. Give the general form of LPP.
A general form of LPP is one which consists of an objective function, constraints and non – negativity restrictions. All are linear.
3. Give the general form of LPP in matrix notation?

$$\text{Opt } Z = C_{1 \times n} X_{n \times 1}$$

$$\text{s.t. } A_{m \times n} X_{n \times 1} (\leq \geq) B_{n \times 1}$$

$$X_{n \times 1} \geq 0$$

4. Mention the steps involved in formulation of LPP.
 - a. Identify the decision variables.
 - b. Identify the objective function and express that in linear function of decision variables.
 - c. Identify the constraint and express them as linear inequality or equations of decision variables.
5. Mention a method of finding a solution to an LPP with two variables.
Graphical (geometrical) method
Simplex (algebraic) method
6. In an LPP define
 - i) Solution : A set of values of decision variables which satisfies the constraints.

ii) Feasible solution: A set of values of decision variables which satisfies the constraints and non negativity restrictions.

iii) Optimal solution : A feasible solution which optimize the objective function of a general LPP.

iv) Objective function : The function which is to be optimized is objective function

v) Decision variables :
The unknown variables whose values have to be determined are decision variables.

vi) Unbounded solution :
In case of maximization problem when LPP possess infinite solution is called unbounded solution.

vii) Multiple solution : A LPP is said to have multiple

- solution if there exist more than one optimum solution.
7. Write down the steps in the graphical method of solving LPP.
- a. Convert the inequality in the constraints or equality.
 - b. Obtain the points to be plotted on the graph and draw the lines corresponding to the equations.
 - c. Identify the feasible region on the graph.
 - d. Evaluate the value of the objective function at the corner points.
 - e. The corner point which gives the optimal value of the objective function is optimal solution in given LPP.

8. The graphical solution to the LPP lies in the first quadrant. Give reason.
Because, non-negativity restriction is satisfied only in first quadrant.
9. Which of the two feasible solutions (12, 10) and (14, 4) of an LPP maximizes the objective function $Z=5x+4y$.
At (12, 10) $z = 5 \times 12 + 4 \times 10$
 $= 100$ (max)
At (14, 4) $z=5 \times 14 + 4 \times 4 = 86$
(optimum solution = (12, 10))
10. Consider the following LPP
 $\text{Max } z = 5x + 3y$
 $\text{st } x + 3y \leq 10$
Suppose $x = -3$ and $y=4$. Is it a feasible solution to the given LPP. Give reason.
No, because $x < 0$

TRANSPORTATION PROBLEM (TP)

11. Describe a transportation problem and gives its mathematical formulation.
Transportation problem is one which determine the quantity of units to be transported from various origins to destinations at minimum cost.
The general form :
$$\min z = \sum \sum C_{ij} x_{ij}$$
$$\text{s.t. } \sum x_{ij} = a_i, \quad \sum x_{ij} = b_j, \quad x_{ij} \geq 0$$
12. In a TP, define the terms.
i) A feasible solution : A set of non negative value X where $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$ which satisfy following conditions.
a) $\sum x_{ij} = a_i, \sum x_{ij} = b_j, x_{ij} \geq 0$
13. In a TP, when do you say that a solution is degenerate?
When the number of positive

allocations is less than $m+n-1$ then the solution is said to be degenerate.

14. What do you mean by a non degenerate solution in a TP? When the number of positive allocations is equal to $m+n-1$ then the solution is non degenerate.
15. When is a TP balanced?
A TP is said to be balanced if $\sum a_i = \sum b_j$
16. What is an unbalanced TP?
ATP is said to be unbalanced if $\sum a_i \neq \sum b_j$
17. Mention any 2 methods of obtaining initial basis feasible solution for TP.
 1. North West Corner Rule Method (NWCR)
 2. Matrix Minima Method (MMM)

GAME THEORY

18. What is a n person game?
A game in which n persons participate.
19. Write down the characteristics of a competitive game?
- There are finite number of players.
 - Each player has finite number of courses of action.
 - A game is said to be played when each player chooses one of his moves.
 - Every combination of course of action is associated with an outcome (Profit/lose)
20. What do you mean by Zero sum game?
A game in which sum of the pay-offs of the players is zero, is called zero sum game.

21. What are the properties of a rectangular game?
- a. Number of players is two
 - b. The gain of one player is the loss of the other player.
22. DEFINE
- 1.Strategy – The predetermined rule by which a player determines his course of action is called strategy.
23. Pure strategy – If a player decides to use only one particular course of action irrespective of course of action chosen by his opponent during every play is called pure strategy.
24. Mixed strategy – the probability combination of pure strategies is called mixed strategy.
- What is meant by rectangular (2 person Zero sum) game
It is a game in which 2 person

participate and the gain of one player is the loss of the other.

- What do you mean by value of a game?

The value of a game is the expected gain of a player a when both the player adopt optimal strategies.

- What is a saddle point?
When do you say that a game has saddle point?
It is a position where the maximin & minimax coincide is called saddle point.
it exists when
 $\text{maximin} = \text{minimax}$.

25. What do you mean by value of a game? What is the value of a fair game?

The value of the payoff at the saddle point is called value of a game, or

It is the expected gain of player A when both the players adopt optimal strategies.

The value of a fair game is zero.

26. Explain the maximin – minimax principle of solving a rectangular game.

The maximum of the row minimums is maximin where as minimum of the column maximums is called minimax. This principle determines the optimum strategies for both the players. (Which maximizes the profit of player A and minimizes the loss of player B)

27. Explain the principle of dominance of solving a rectangular game. This method helps in reducing the size of the pay off metric by deleting some strategies according to certain rules. It is based on the principle that if the strategy of a player dominates over

the other strategy then the latter strategy can be eliminated.

28. In a two person – zero sum game if gain of one player is Rs. 3 then what is the loss of the other player?

Ans : 3

29. In a rectangular game, If saddle point exists and maximin is – 4 what is the value of minimax.

Minimax = -4

30. If in a game the pay off at saddle point is 4, what is the value of minimax.

Minimax = 4

31. In a game of matching coins with two players, suppose A wins Rs. 10 when the coins show two heads, wins Rs. 5 when the coins show 2 tails and loses Rs. 4 when the coins

show 1 head and 1 tail, write the pay off matrix of A. Does the game have saddle point if so, write down the solution.
Solution : Pay off matrix

		B	
Player A			
		10	-4
		-4	5

saddle point does not exists

32. If value of the game is -6, is the game fair?

No

33. Solve the following game using Minimax – maximin principle

	A	B	C
P	1	-1	3
Q	2	-1	2
R	-1	0	0
S	2	0	4

Pure strategy for x : S
 Pure strategy for Y : B
 Value = 0 (fair game)

34. The following is the pay off matrix of player A, write the pay off matrix for B.

	A	B
P	3	2
Q	5	4
R	0	-1

Ans :

	P	Q	R
A	-3	-5	0
B	-2	-4	1

35. If in a game, $v=5$, $\alpha \& \beta = ?$
 Ans : 5

REPLACEMENT PROBLEM

36. What do you mean by replacement problem?
It is one which decides the age at which an item (which deteriorate with time) has to be replaced by a new one.
37. Mention two situations when replacement is carried out.
- i. When equipments deteriorate with time
 - ii. The maint. cost increases and efficiency decreases.
38. Give one example for equipments which deteriorate with age.
Examples: Men machines, and other materials.
39. Write the principle adopted for replacement of equipments

which deteriorate with age?
The equipment should be replaced at the end of the year for which the annual average cost is least. OR
The equipment should be replaced when annual avg. Cost stops decreasing and starts increasing.

40. Mention any two needs for replacement of equipments.
- a. Items becomes inefficient with passage of time.
 - b. Maintenance cost increase with age.
 - c. Modern items are more efficient compact and attractive
41. Write the formula for calculating total cost incurring during

'n' years in a replacement problem.

$$T(n) = P - Sn + \sum f(t)$$

P= capital cost

S= Scarp value

f(t)=Maintenance cost

INVENTORY THEORY

42. What is meant by inventory
It is a physical stock of goods kept for further use.
43. What are the advantages and disadvantages of inventory.
Advantages :
- a. Bulk production decreases production cost, transportation cost etc.
 - b. Customer satisfaction.
 - c. Reduces the set up cost.
 - d. Helps in smooth and efficient running of business.

Disadvantages : The following costs are associated with inventory, ware house rent, interest on capital, labour, loss due to depreciation etc.

44. List the types of variables associated with an inventory. The variables associated with the inventory problem are of two types.
- a. Controlled variables
 - b. Uncontrolled variables.
45. What are controlled variables? Give examples. The variables that may be controlled are called controlled variables.
- Ex: Quantity of goods acquired, Frequency of replenishment, Completion stage of stocked items.

46. Give examples for uncontrolled variables.
Examples : Inventory costs
Demand
Lead time
47. Mention different types of costs associated with an inventory.
Warehouse rent
Interest on capital
Labour on maintenance
Loss due to depreciation and deterioration
Loss due to damages.
48. Define holding cost.
The cost associated with the maintenance of an inventory until they are sold or used is called holding cost (C_1). It includes rent on space, interest on capital insurance

premium, spoilage, breakage, maintenance of records.

49. Define ordering cost.
The cost associated with placing an order for goods is called ordering cost.
50. Define set up cost.
The cost associated with setting up of machinery before starting production is called the set up cost. It is the cost per production run. (c3). It includes purchase cost, labour cost, transportation cost, quality control etc.
51. On which factor set up cost is assumed to be independent.
Quantity produced.
52. Define shortage cost.

The cost associated with either a delay in meeting the demand or inability to meet the demand is called shortage cost (c₂)

53. Define capital cost.
The cost associated with manufacturing or purchasing an item is called capital cost.
54. Write down the general inventory model.
Total inventory cost=Capital cost+setup cost+holding cost+shortage cost
55. What is the objective of inventory theory.
The inventory theory is to decide how much stock to be maintained and when to place order with minimum total inventory cost.

56. Define

1. Stock replenishment
2. Demand
3. Lead time
4. Time horizon
5. EOQ / ELS

Stock Replenishment : The revival of stocks or refilling the inventory in order to maintain a certain level is called stock replenishment it may be uniform or instantaneous.

Demand : The number of units required from the inventory is called demand.

It may be deterministic or probabilistic.

Lead time : The time between ordering and receiving an item is called the lead time.

Time horizon : It is the time period over which the inventory level is maintained is

called time horizon. Usually it is taken as one year.

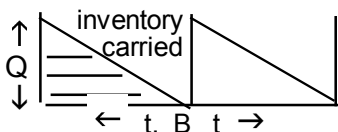
The Quantity of goods acquired or ordered quantity in the inventory which minimises the carrying cost and ordering cost is called EOQ.

The lot size (produced in one lot) which minimises the carrying cost and ordering cost is called ELS

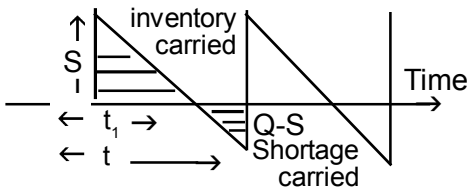
57. under what conditions is EOQ model with shortage applicable. Conditions are :

1. Uniform Demand
2. Instantaneous Production
3. Shortages are allowed
4. Lead time is zero

58. Diagrammatically represent EOQ without shortage (model I)



59. Diagrammatically represent model II



60. Given :

Set up cost = Rs. 50/cycle,
 Storage cost = Rs 3/item/yr.
 Demand = 5000 items /yr
 Calculate min.avg.cost

$$\begin{aligned} \text{A: min.avg cost} &= \sqrt{2C_1C_3R} \\ &= \sqrt{2 \times 50 \times 3 \times 5000} = \text{Rs. 1225} \end{aligned}$$

Unit VIII : Statistical Quality control

1. What is meant by quality ?
Quality is an attribute of the product that determines its fitness for use.
2. What is 'natural tolerance' ?
The range of chance variation is called natural tolerance.
3. What is meant by SQC ?
The control of quality of manufactured articles using statistical techniques is called SQC .
4. Mention the three stages of production process.
Specification
Production
Inspection
5. Mention two uses of SQC.
 - i. Improves the quality and decrease the production of defectives.
 - ii. Eliminates the faults, prevents the loss due to spoilage

and rework.

iii. Provides greater quality assurance at minimum inspection cost.

6. Mention two types of causes for variation in a manufacturing process.

Assignable cause.

Chance cause

7. What are assignable and chance causes.

The variation that can be observed in the quality of the product, where the causes can be identified and eliminated.

Chance causes :

A small amount of variation for which no specific cause can be attributed is called chance cause of variation

8. Which cause of variation can not be eliminated from process control.

Chance cause of variation

9. What is the meaning of 3sigma limits.

In SQC we assume the production process follows ND. In ND, probability of the variate lies between the 3sigma limits is 0.9974 i.e., the process is under control if 99.74% of the observations lie within 3sigma limits.

10. In R chart if one of the sample range lie outside the control line. what is your conclusion ?

Ans : Process (variation) is out of control

11. What is acceptance sampling ?
The process of inspection of manufactured lot for acceptability

12. If $\bar{c} = 2$ find UCL.

$$UCL = \bar{c} + 3\sqrt{\bar{c}} = 6.2426$$
13. Name the control chart used in the case of defectives. in SQC.
 np or d chart
14. Name the control chart for process variation in SQC.
 R chart
15. SQC helps in detecting which type of variation
 Assignable variation.
16. Define : i. process control
 ii product control (acceptance sampling)
 controlling the quality of the goods, during the manufacturing process is called process control.

The process of inspection of manufactured lot for acceptability is called product control, or acceptance sampling.

17. Name the control chart used in case of defectives in SQC np-chart or d-chart.

18. What is a control chart ?
Name the control chart for variables.
Control chart is a graphical device used to verify whether the production process is in statistical control or not
The control charts for variable are
 \bar{X} - chart
R - chart.

19. What are upper and lower control limits ? What is the

conclusion, if an observation falls outside the control limits
The lower control limit is the minimum acceptable variation (from the average quality level) for a process.

The upper control limit is the maximum acceptable variation from the mean for a process.

20. What does the central line indicates in a control chart ?
C.L. indicates the average quality level.
21. What is the conclusion if an observation falls outside the control limits ?
The process is out of control.
22. Mention the different types of control charts

Types of control charts :

1. Control charts for variables

a) \bar{x} - charts

b) R - chart

2) Control charts for attributes

a) np charts

b) c- chart

23. What are defects and defectives

A quality characteristic which does not conform to specifications is called a defect.

An Item having one or more defects is called a defective.

24. Give an example for defect in a product. Broken corner of a glass pane, misprints, damages in a weaving cloth, a bubble in the glass bottle, an insect in fruit, fold or scratches in a paper etc.,

25. Give an example for defective in a product.
The cloth containing mis prints, a glass bottle with air bubbles, a paper with scratches. etc.,
26. What are SSP and DSP.
SSP is one in which sampling is done on the basis of one sample. DSP is one in which acceptance sampling is based on two samples
27. mention 2 differences between SSP & DSP.
1. SSP based one only one sample DSP is based on 2 Samples
2. Design and testing procedure are simple in SSP Testing procedure is not so simple as DSP

3. SSP is not much reliable.
DSP is more reliable
4. SSP is Less expensive
DSP is more expensive
28. Mention two advantages of acceptance sampling
Its helps to decide whether desirable quality has been achieved
It is used when the items are destructive
It is less expensive
29. Mention two disadvantages of acceptance sampling plan.
 - i. Since it is based on samples, there is a risk of accepting a bad lot and rejecting a good lot.
 - ii. Timely identification of the production of defectives can't be achieved
 - iii. It is not complete some extra planning and documentation is necessary.

30. Briefly explain SSP
 Let N = the lot size
 n = sample size
 d = no. of defectives in the sample
 c = acceptance number.
 Procedure :
- Take a random sample of size (n)
 Note the number of defectives ($=d$)
 - If $d < c$ accept the lot
 - if $d > c$ Reject the lot
 Replace the defective items by good ones.
31. Write the control limits for np-chart & e-chart when the std.s not given
 $CL = np$
 $UCL = np + 3\sqrt{npq}$
 $LCL = np - 3\sqrt{npq}$
32. Measurements of metal holders for different samples of size 5, each gave the results

$\bar{x} = 80.3$ and $R=5.2$ Find the values of control limits for drawing \bar{x} chart ($A_2=0.577$)

$$Cl = \bar{x} = 80.3$$

$$LCL = \bar{x} - A_2 R = 80.3 - (0.577) 5.2 = 77.30$$

$$UCL = \bar{x} + A_2 r = 80.3 + (0.577) (0.52) = 83.3$$

33. Calculate control limits for d-chart given that $p = 0.05$ and $n= 5$

$$CL = nP = 5 (0.05) = 0.25$$

$$LCL = nP - 3\sqrt{npq} = 0.25 - 3 \times 0.05 \times 0.95 = -1.21 = 0$$

$$ucl = p + 3\sqrt{npq} = 1.712$$

Control Limits	<u>X - Chart</u>	
	Stds Given	Stds Not Given
CL	$\bar{\bar{x}}^1$	$\bar{\bar{x}}$
LCL	$\bar{\bar{x}}^1 - A\sigma^1$	$\bar{\bar{x}} - A_2\bar{R}$
UCL	$\bar{\bar{x}}^1 + A\sigma^1$	$\bar{\bar{x}} + A_2\bar{R}$

$\bar{\bar{x}}^1$ & $\sigma^1 \longrightarrow$ given Standards

Control Limits	<u>R - Chart</u>	
	Stds Given	Stds Not Given
CL	$d_2\sigma^1$	\bar{R}
LCL	$D_1\sigma^1$	$D_3\bar{R}$
UCL	$D_2\sigma^1$	$D_4\bar{R}$

n = Sample size

K = no.of samples

np(d) Chart

Control Limits	Stds Given	Stds Not Given
CL	np^1	$n\bar{p}$
LCL	$np^1 - 3\sqrt{np^1q^1}$	$n\bar{p} - 3\sqrt{n\bar{p}\bar{q}}$
UCL	$np^1 + 3\sqrt{np^1q^1}$	$n\bar{p} + 3\sqrt{n\bar{p}\bar{q}}$

P^1 = Give Standard

d = number of defectives

$$\bar{p} = \frac{\sum d}{nk}$$

C - Chart

Control Limits	Stds Given	Stds Not Given
CL	λ^1	\bar{c}
LCL	$\lambda^1 - 3\sqrt{\lambda^1}$	$\bar{c} - 3\sqrt{\bar{c}}$
UCL	$\lambda^1 + 3\sqrt{\lambda^1}$	$\bar{c} + 3\sqrt{\bar{c}}$

λ^1

→ Given Standard

c = number of defects

k = no. of samples

$$\bar{c} = \frac{\sum c}{k}$$

	Model	Model II
EOQ/ELS	$Q^0 = \sqrt{\frac{2C_3R}{C_1}}$	$Q^0 = \sqrt{\frac{2C_3R}{C_1}} \sqrt{\frac{C_1+C_2}{C_2}}$
Re ordertime	$t^0 = Q^0/R$	$t^0 = Q^0/R$
opt. no. of orders (frequency of Replenishment)	$n^0 = R/Q^0$	$n^0 = R/Q^0$
Min.average cost	$Tc(Q^0) = \sqrt{2C_1C_3R}$	$\sqrt{2C_1C_3R} \sqrt{\frac{C_2}{C_1+C_2}}$
Max. inventory level	Q^0	$S^0 \frac{C_2 Q^0}{C_1+C_2}$
Max.shortage level	—	$Q^0 - S^0$

Notations:

C - Purchasing / Production / Capital Cost

C_3 - Setup/ordering/ Replenishment / Procurement cost

C_1 - Holding / Storage/Carrying/maintenance cost

C_2 - Shortage/Penalty cost

R - Demand rate

Interpretation : Inventory policy suggest that Q^0 units should be ordered every t^0 years and the inventory cost is $Tc(Q^0)$ rupees/year.

No. of orders /year = n^0

Some more points to be considered:

Fertility refers to the births occurring to women of child bearing age.

A Measure of fertility (No. of births occurring) is fertility rate.

Mortality refers to deaths occurring in the population.

A Measure of mortality is mortality rate.

The size of the cohort is radix

The size of the radix is 100000.

What is the method of Least Squares ?

It is a mathematical method of measuring trend of the type $Y = f(x)$

What are normal equations ?

The process of minimisation of sum of squared errors result in sum equations are called normal equations.

What is value index number ?

It is the effect of combination of price and quantity changes between two time periods i.e. $V_{01} = V_1 / V_0 \times 100$

What is operation research ?

Operation means some action that is applied to certain problems. Research means the process of seeking facts about the problems.

OR is the method of application of scientific methods , techniques to the problems involving the operation of a system so as to provide the system with optimum solutions to the problem.

The areas where OR applied are

1. Allocation (resources such as Men, Machine, Money, Time etc.)

2. Production Management
3. Marketing Management
4. Procurement (finding quality , Time of purchase of raw materials ,machines etc.)
5. Personality management, Finance.
6. Research and Development

Eg. LPP is used in industries for effective use of Men , Machine , Money and Material.

Game Theory is applied in conflicting situations, to suggest the best strategy for the players.

Replacement Theory helps in finding the best Time period to replace an equipment or specific part in manufacturing process.

Transportation Theory helps in shipment of goods at minimum cost from sources to destinations.

Inventory Theory helps in organising stocks and maintaining costs.

Mention the applications of LPP?

It is used in product allocation, production mix problem, diet problem etc.

When do you say that the process is out of control?

- a. One or more points lie outside the control limits.
- b. A run of seven or more points lie to one side of the central line.

What are the components of T.S.?

The factors which are responsible for the fluctuations in the time series.

Identify the distributions associated with the following cases

- ◆ No. of Male children born when a baby is born. (Bernoulli)
- ◆ No. of deaths occurring in a city. (PD)
- ◆ No. of vegetarians in a sample of 8 selected from a hostel in which there are 12 vegetarians and 8 non vegetarians. (HGD)
- ◆ No. of telephone calls coming in the time interval 10Am to 10.10 AM (PD)
- ◆ Marks scored by students in an exam. (ND)

- ◆ The amount money saved by a person. (ND)
- ◆ The no. compliants received by a company in a month. (PD)
- ◆ No. of Heads obtained in four tosses of a coin.(BD)
- ◆ No. of customers arriving at the super market per hour.(PD)
- ◆ The time in minutes that a person has to wait at a station for a train. (ND)
- ◆ No. of male children in a family of 4 children (BD)
- ◆ No. of defects found in unit metre cloth. (PD)
- ◆ No of seeds germinating (or fails to germinate)among 10 seeds sown.(BD)
- ◆ Heights of students of a college.(ND)
- ◆ No. of defectives in a random sample of 6 articles drawn from a manufactured lot. (BD)
- ◆ No. of bombs hitting the bridge when a bomb is dropped from the aeroplane.(Bernoulli)

♦ The no. of boys in a committee when 5 boys are selected from 30 boys and 20 girls. (HGD)

♦ No. of road accidents occurring in a city (PD)

♦ No. of vehicles crossing a junction in 1 minute. (PD)

♦ No of heads obtained in toss of a coin. (Bernoulli)

♦ No. of white balls in selection of 4 when there are 5 white and 6 black balls. (HGD)

No. of print mistakes per page in a text book. (PD)

No. of bacteria in cubic centimetre of water. (PD)

IQ of large group of children (ND)

The no. of radio active particles emitted from a radio active substance in a fraction of a second. (PD)

The income of persons working in an organisation. (ND)

What are vital events?

The events of human life such as Births, Deaths, Sickness, Marriage, Divorce, Migration etc. are called as vital events.

When do you say that a Binomial Distribution is symmetric, negatively skewed and positively skewed?

If $p=0.5$ BD is symmetric $\beta_1=0$

If $p>0.5$ BD is negatively skewed $\beta_1<0$

If $p<0.5$ BD is positively skewed $\beta_1>0$

When mean and mode are equal in a BD?

When np is integer

How many No. of modes are there in a ND?

One (unimodal)

When will be a PD is Unimodal?

When λ is integer

What is the value of unique mode of a PD?
Integral part of λ .

What is the value of skewness and kurtosis of a PD?

$\beta_1 > 0$ (positively skewed)

$\beta_2 > 3$ (Lapto curtic)

*Let us remember some of the
scientiests and their contributions*
(Not for Examination)

- ◆ R.A. Fisher - Father of modern statistics,
Index number and TRT, FRT.
- ◆ Karl Pearson - S.D. , Coeff. of Skewness,
Co-relation Coeff., χ^2 Goodness of fit test
- ◆ Bowley - Coeff. of Skewness
Spearman - Rank correlation Coeff.
- ◆ W.A. Schewartz - Control charts
- ◆ James Bernoulli - Bernoulli , Binomial
distribution
- ◆ Poisson - Poisson distribution
- ◆ Gauss - Normal distribution
- ◆ W.S. Gosset (student) - t distribution

Please visit to you tube :

1. II PU Statistics seminar on Poission distribution by Sidhi Chopra
2. II PU Statistics seminar on Time Series by Vaishnavi
3. II PU Statistics seminar on Paired t-test by Soundarya M.
4. II PU Statistics seminar on Chi-sqaure test for goodness of fit by Swastika
5. II PU Statistics seminar on Consumer Price Index Number by Rachana
6. Model question paper prepared by I Sonia V. Soni ii Sidhi Chopra
7. II PU Statistics seminar on Normal distribution by Shreya Chopra
8. 1st prize winners Folk dance by Sonia & Group @ SRS Sankranthi grand finale
9. 1st prize winners Film dance by Shreya & Group @ SRS Sankranthi grand finale

Notes

Notes

Corrections

Pg.	Q. No	Corrections
1	5	... bearing age ...
4	22	.. beginning and at the end ...
4	24	mortality
6	26	events occurring in human population
7	29	actuarial
19	20	weight age
37	10	random variation
40	18	RV (unpredictable), SV (predictable)

Our Salutations to the Doyen of Statistics Prof. C.R.RAO.

* If there is a problem to be solved seek statistical advice instead of appointing a committee of experts. Statistics can throw more light than the collective wisdom of the articulate few.

* Statistics is the best weapon for fighting against fraud, Superstition and injustice.

* The failure of Statistician is not the failure of statistics, as the failure of a reasoner is not the failure of reason.

* For Successful Policy making a Government needs good Statistics as well as good Statisticians. One is not a substitute for the other.

* The need for knowing the three R's (reading, writing and arithmetic) is well known. These do not take us far unless we acquire also the skill in the fourth R, reasoning under uncertainty for taking decisions with minimum risk, which is the subject matter of Statistics.

(Collected from popular lectures and writings of Prof. C.R.Rao Sir on Statistics)

